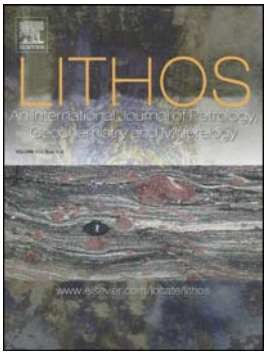

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Mantle heterogeneities beneath the Northeast Indian Ocean as sampled by intra-plate volcanism at Christmas Island

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Abstract

The intra-plate region of the Northeast Indian Ocean, located between the Ninetyeast Ridge and the North West Shelf of Australia, contains numerous submerged seamounts and two sub-aerially exposed volcanic island groups. While the Cocos (Keeling) Archipelago is a coral atoll, Christmas Island is the only sub-aerially exposed volcanic island and contains Late Cretaceous, Eocene and Pliocene lavas. The lavas are predominantly basaltic in composition, except for one sampled flow that is trachytic. Although the evolution of the western margin of Australia, and the seismicity in the intra-plate region, has received considerable attention, the origin of the seamount province in the Northeast Indian Ocean is still a matter of debate. In order to constrain the origin of volcanism on Christmas Island and the associated Seamount Province we analysed 14 Christmas Island samples for major and trace element abundances and 12 of these for Nd, Hf and Pb isotope compositions. The trace element patterns of the lavas are similar to many ocean island basalts, while high $^{208}Pb/^{204}Pb$ and $^{207}Pb/^{204}Pb$ at a given $^{206}Pb/^{204}Pb$ suggest affiliation with the DUPAL anomaly. The reconstructed position of Christmas Island during the Eocene (44 – 37 Ma) places the island in close proximity to the (present-day) upper mantle low-seismic velocity anomalies. Moreover, an enriched mantle (EM-2) type component in addition to the DUPAL anomaly is observed in the Eocene volcanic phase. The younger Pliocene (~4 Ma) sequences at Christmas Island are inferred to be the product of partial melting of existing material induced by lithospheric flexure.